Atmosphere

Properties, Composition and Measurement

GRADE LEVELS

Grades 5 – 8

OBJECTIVES

While completing the following activities, students will:

- Describe the layers of the atmosphere and the characteristics of each layer.
- Identify the chemical composition of the atmosphere.
- Describe and measure atmospheric pressure.
- Describe and measure relative and absolute humidity

KEY WORDS

absolute humidity
altitude
atmosphere
atmospheric dust
auroras
barometer
exosphere
forecasting
greenhouse effect
ionosphere
jet streams
mesosphere
nitrogen
oxygen
ozone
pressure
psychrometer
relative humidity
stratosphere
temperature
thermosphere
troposphere
water vapor

BACKGROUND INFORMATION

The **atmosphere** is the layer of gases and particles that surrounds Earth. The atmosphere has an influence on almost every living thing. The air you breathe is part of the atmosphere. The atmospheric temperature of the day determines how you dress and what many of the activities in your life will be such as swimming on a hot summer day or skiing on a cold winter day.

Earth is surrounded by a blanket of air that extends to about 1,000 kilometers (km) above its surface. The molecules of gas are trapped by the pull of the earth's gravity. The atmosphere surrounds Earth and protects us by blocking out dangerous rays from the sun. The atmosphere is a mixture of gases that becomes thinner until it gradually reaches space. It is composed of **Nitrogen** (78%), **Oxygen** (21%), and other gases (1%). These gases are essential to life here on Earth. Most of the gases were ejected from the earth's crust during long periods of volcanic activity.

The atmosphere also contains many different kinds of tiny particles called **atmospheric dust**.

The dust can be made up of soil, ash from fires and volcanoes, microscopic organisms, meteor particles, and ocean salt.

Water vapor is another important part of the atmosphere. Water vapor is added to the air by evaporation from the oceans, lakes, ponds, streams, and even the soil. Plants also give off water vapor. The amount of water vapor in the air determines the **humidity** level of the air.

In addition to the oxygen, in the form of O_2, in the air some of the oxygen has changed over time forming **ozone** (O_3). The ozone layer filters out the sun's harmful ultraviolet (UV) radiation. Without the ozone in the atmosphere, people would be severely sunburned by the ultraviolet rays. Recently, there have been many studies on the ozone layer connected to the **greenhouse effect** and the depletion of the ozone layer. Scientists believe that the greenhouse effect is increasing the earth's temperature by trapping the sun's energy. Scientists also believe that gases from aerosol spray cans, coolant from refrigerators and air conditioning units as well as other hydrocarbons are reducing the amount of ozone in the atmosphere.

The atmosphere is separated into five distinct layers based on the temperature changes that occur from one layer to the next. It is thickest near the surface and thins out with **altitude** until it eventually merges with space. In general, the density, temperature and pressure of the air decrease with elevation.

The **troposphere** is the first layer above the surface and contains half of the Earth's atmosphere. This is where we live and where most weather occurs. As you go higher into the troposphere, the temperature drops. Air in the troposphere is heated from **the ground up. The sun's rays heat the surface of the earth, not the** air directly. The surface of the Earth absorbs energy and heats up faster than the air does. Therefore, air closest to the ground is the warmest. The thickness of this layer varies from 17.6 km at the equator to 6.4 km at the poles.

The **stratosphere** lies above the troposphere. Air in the stratosphere is thinner than in the troposphere. It contains very little moisture and dust. As a result, practically no weather phenomena exist. Many jet aircraft fly in the stratosphere because it is so stable. In Earth's stratosphere, the temperature increases with altitude. On Earth, ozone causes the increasing temperature in the stratosphere. Ozone is found in this layer about 15 - 50 km high with the highest concentrations around 25 km. It is a form of gas that absorbs most of the harmful ultraviolet rays from the sun. A significant reduction in ozone would cause an unhealthy increase in radiation.

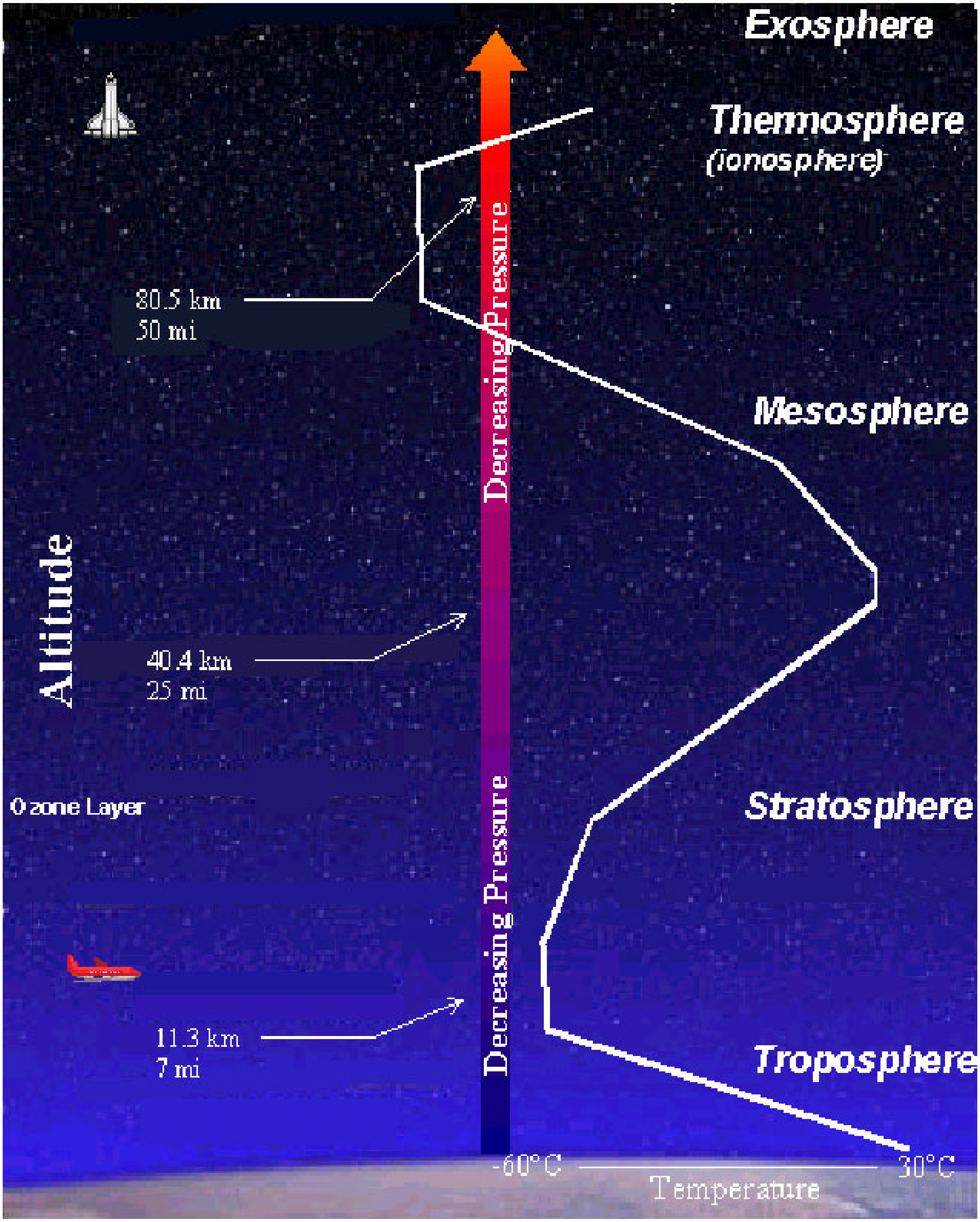
The stratosphere also contains broad, fast-flowing "rivers" of air circulating around the world. These are called **jet streams**. The jet streams can change weather patterns in the troposphere. Above the ozone layer of the stratosphere, temperature begins to drop once more. This is the beginning of the **mesosphere**.

The mesosphere is on top of the stratosphere. This is the layer in which a lot of meteors or rock fragments burn up while entering Earth's atmosphere. In Earth's mesosphere, the air is relatively mixed together and the temperature decreases with altitude. The atmosphere reaches its coldest temperature of around -90°C in the mesosphere. Temperatures begin to rise again in the top layer of the atmosphere, called the **thermosphere**. The gases

continue to thin out to an altitude of about 600 km.

The thermosphere is the layer with auroras. Auroras occur when high-energy electrons race along the planet's magnetic field and into the upper atmosphere where they excite atmospheric gases, causing them to glow. (http://ericir.syr.edu/Projects/Newton/10/lessons/Borealis.html) The thermosphere is also where the space shuttle orbits. The air is really thin in the thermosphere and a small change in energy can cause a large change in temperature. This is why the temperature is very sensitive to solar activity. When the sun is active, the thermosphere can heat up to 1,500°C or higher! The Earth's thermosphere also includes the region of the **atmosphere called the ionosphere**. The ionosphere is a region in the lower part of the thermosphere that is filled with charged particles. The high temperatures in the thermosphere can cause molecules to ionize. Therefore the ionosphere and thermosphere can overlap. The ionosphere is important in communications because it can reflect many types of radio waves allowing them to bounce around the world.

The atmosphere merges into space in the extremely thin **exosphere**. This is the upper limit of our atmosphere. This layer is extremely thin and atoms and molecules escape into space.


Exosphere
Thermosphere
(ionosphere)
80.5 km
50 mi
Decreasing Pressure
Mesosphere
Altitude
40.4 km
25 mi
Ozone Layer
Stratosphere
Decreasing Pressure
11.3 km
7 mi
Troposphere
-60°C
30°C
Temperature

ACTIVITY ONE
What is the atmosphere made of?

In this activity, students will investigate the composition of air and some sources for the chemicals in the air.

TEACHER PREPARATION

Draw a pie graph on chalkboard showing the four major gases in the air: nitrogen (N_2) 78%- essential to all plants and animal tissue; oxygen (O_2) 21%- utilized in respiration; argon (Ar), carbon dioxide (CO_2) and neon (Ne) less than 1% ; and Helium (He), Methane (CH_4), Krypton (Kr) and Hydrogen (H_2) make up most of the rest. Locate the elements on a periodic table. Discuss with students some uses for the major gases in the air.

Carbon, hydrogen, oxygen and nitrogen make up 96% of a human's body mass. Organisms need oxygen to release the energy from their food. Animals, fires and weathering, such as rust, remove oxygen from the air. Plants replace oxygen in the atmosphere through photosynthesis. Plants and animals do not use nitrogen directly from the atmosphere. Plants obtain it from the soil. Animals obtain it from eating plants. Hydrogen makes up 90% of the gases in the universe but less than 0.5% of the gas in our atmosphere. Hydrogen is unlike any other element. It reacts very quickly with most other elements. It is used with oxygen as fuel for the space shuttle and in fertilizers like ammonia. Neon is the fourth most abundant element in the universe and is useful for advertising signs. Krypton and argon are also used in advertising lights and light bulbs. Helium is very stable and is used in weather, scientific and toy balloons. Methane is a natural gas used as a fuel in heating and cooking. Carbon dioxide is used by plants in the process of photosynthesis. It is the gas that we exhale into the air.

Discuss the concept of the layers of Earth's atmosphere by showing the model of the atmosphere on the overhead projector or by drawing a model on the chalkboard. Relate to them that Earth is surrounded by a blanket of air that extends 1000 km or 100 miles above its surface. The air molecules are trapped by the pull of gravity from Earth's surface. Therefore, the air pressure closest to Earth is the highest.

Have students make their own models, or draw pictures to reinforce the concepts.

In order to complete the following activity, you will need to collect a sample of car exhaust in a balloon. Cut off the bottom of a small plastic water bottle. Wrap the mouth of a balloon over the mouth of the bottle. While a car is running carefully place the bottom of the bottle over the exhaust pipe and fill the balloon as much as possible. Be very careful as the tail pipe may be hot. It is best to use a car that has not been running for a while.

MATERIALS

- Bromthymol blue solution
- Straws
- Vinegar
- Baking soda
- Balloons
- Two empty small plastic water bottles
- Three small plastic cups or beakers
- small plastic or paper funnel
- Automobile exhaust

QUESTIONS

- What is the composition of air?
- Where do carbon gases come from?

PROCEDURE

Step 1
Pour approximately ¼ cup of bromthymol blue solution into each of two small plastic cups or beakers.
Step 2
Look at the size of the balloon filled with exhaust that the teacher has prepared. Blow into your balloon until it is the same size as the exhaust balloon.
Step 3
Keeping the balloon closed tightly, cover the end of a straw with the mouth of the balloon so that when you open the balloon the air will be channeled through the straw only. Put the other end of the straw into the bromthymol blue solution and slowly release the air into the solution until the balloon is empty. Observe any changes in the solution.
Step 4
Using a funnel, pour approximately ¼ cup of vinegar into a small water bottle. Using a clean and dry funnel pour 2 tablespoons of baking soda into a balloon. Making sure not to pour out any of the baking soda, cover the mouth of the bottle with the mouth of the balloon. Once the balloon is secure over the bottle pour the baking soda from the balloon into the bottle. Hold the balloon securely on the mouth of the bottle while the balloon is filling with gas. Fill the balloon until it is the same size as the exhaust balloon your teacher has. When it is filled to the right size close it off and quickly remove it from the bottle before too much pressure builds up in the bottle. Repeat Step 3 with the second cup of bromthymol blue solution. Observe any changes in the solution.
Step 5
Your teacher will repeat **Step 3** with his/her balloon filled with exhaust from a car. Observe any changes in the solution.

CONCLUSION

- Discuss the difference in the cups of bromthymol blue solutions.
- Which created more carbon gas?
- Answer the questions posed in the beginning of the activity.

EXTENDED ACTIVITIES

Life as a Particle

Have students write in a journal about their life as a particle falling through the atmosphere. Since particles are small and light is should take several days to fall through the layers of the atmosphere. Have them describe what they experience including temperature changes, other particles they might meet, radiation felt, etc.

Ozone Depletion

Have students investigate using the Internet the effects of carbon gases on the ozone layer. Discuss the usefulness of the ozone layer and the problems with its depletion. Have students investigate conservation and clean up efforts concerning automobile and factory exhaust of carbon gases.

http://ericir.syr.edu/Projects/Newton/10/les-

Acid Rain

The following is a link to a *Newton's Apple* discussion and activity on acid rain.

http://ericir.syr.edu/Projects/Newton/9/acdrain.html

Ozone detection

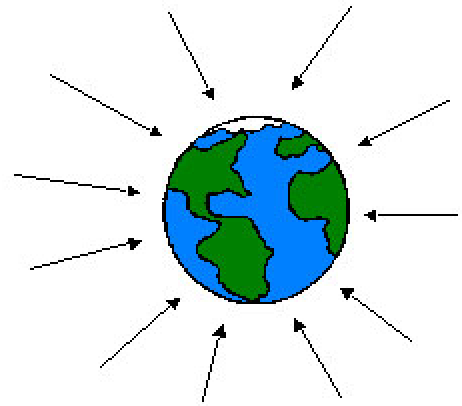
Ozone is a colorless gas. It is found in two layers in the atmosphere. High-level ozone is about 10 to 30 miles above the earth. It is there naturally. This ozone layer protects the earth from the sun's harmful ultraviolet light. Without this protection, the ultraviolet light would be harmful to humans. Ground-level ozone reaches from the ground to about 10 miles above the earth. Ozone at ground level is formed as a result of chemical reactions between oxygen and volatile organic compounds (mainly come from automobile exhaust) and nitrogen oxides (mainly come from industries and power plants) in the presence of sunlight. High concentrations of ground-level ozone are produced during warm weather (summer months).

Ground-level ozone can be very harmful. It can cause breathing problems in humans. It can also injure forests and other vegetation and damage crops. There are various types of ozone detection devices on the market. Have students use these devices throughout their day to measure the amount of ground ozone.

The Upper Atmosphere

The NASA Ultra Long Duration Balloon will be flying above 99% of Earth's atmosphere. At this altitude the amount of air particles is very small. Discuss with students the scientific advantages of being at this position in order to study stars, solar particles and conducting Earth observances.

ACTIVITY TWO
What is atmospheric pressure?



This activity will help students understand atmospheric pressure. The last mini-activity, *Can Crush*, should be done as a demonstration only. *A Heavy Newspaper* activity may also be done as a demonstration for safety reasons.

TEACHER PREPARATION

Pressure is a force *or weight* per unit area. Although we can't see air, the gas molecules still have mass, and gravity acts upon it. The surface of Earth is at the bottom of a "sea" of air called the atmosphere. Anything exposed to air is under pressure - the weight of the atmosphere above it. This weight of air, due to gravity, is known as **atmospheric pressure**. The atmosphere exerts a huge 10-20 tons of pressure on everything on the earth! A column of air one-inch square and about 50 miles high (a distance that encompasses virtually all of earth's atmosphere) weighs just 14.7 pounds. If you lift your hand, you move some air molecules out of the way and other molecules immediately come under and around your hand. The pressure surrounding your hand stays the same: 14.7 pounds per square inch (psi). Because the pressure is evenly distributed, you don't feel the crushing weight. You have probably felt a change in air pressure if you have driven in the mountains or taken a plane ride. The decrease or increase in pressure causes your ears to "pop". Once the pressure inside and outside your ears is the same, the "popping" stops.

The amount of pressure varies from place to place on the surface due to the temperature and moisture content of the air as well as the elevation. Large masses of air with similar air pressures form as a result of these conditions. These masses of similar air pressures are divided into 2 main groups: Highs and Lows. **High pressure** masses generally form over a uniform land or water surface and have equal horizontal temperatures and humidity. They move in a clockwise rotation from the center out in the **Northern Hemisphere** and are sometimes called anticyclones. **Low pressure** masses form along the boundary between air masses having differing temperatures and humidity. In the Northern Hemisphere, air flows toward the center of the Low and moves in a counterclockwise rotation. Lows are sometimes referred to as cyclones. These masses of air can vary greatly in size as they form and move across the Northern Hemisphere. Many changes in weather conditions are due to the passage of differing air masses.

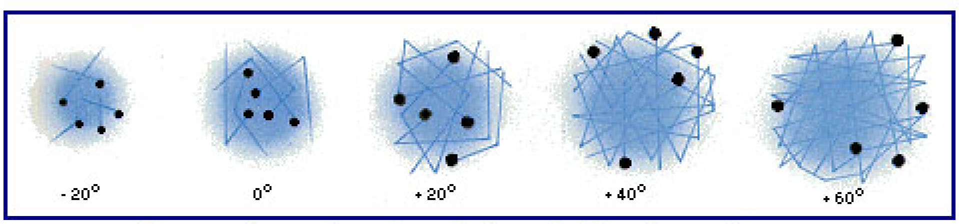
Air pressure is a measure of the weight of the column of air above you. It is always changing. When air is cold and dry it weighs the most and the pressure is high or rising. That tells a weather person that fair weather is on its way. Air that is warm and damp weighs less than dry air and the pressure is low or falling. A drop in air pressure usually signals foul weather ahead.

Weather people use instruments especially made to measure atmospheric pressure. They are called **barometers**. They are important tools for **forecasting** the weather. Some barometers use long glass tubes filled with mercury inverted in a dish. Air pressing down on the surface of the dish forces the mercury up the tube. Normal air pressure can support a column of mercury about 760 mm high. When atmospheric pressure drops, the force of the air pushing on the dish is not as great, so the column of liquid falls and we have a "falling barometer." When the atmospheric pressure increases, the mercury rises, thus a "rising barometer."

We use air pressure all the time when we breathe. When our diaphragm moves down, air is pushed into our lungs from the outside, expanding the volume of the chest cavity. The diaphragm doesn't "pull" air in; it expands the volume of our lungs, and the air pressure fills the volume.

Demonstrate to students how Styrofoam balls can represent air molecules. Show high or low pressure of the air molecules by spacing the balls in a glass jar and by compressing them. For example, high pressure can be shown by pressing down on the balls and moving them closer together.

Briefly review each layer of the atmosphere. Point out that the atmosphere is separated into layers based on the temperature changes that occur from one layer to the next. As we go higher into the atmosphere, the temperature switches from warm to cold, the air molecules get thinner and the pressure decreases. Most weather occurs in the first layer, the troposphere.

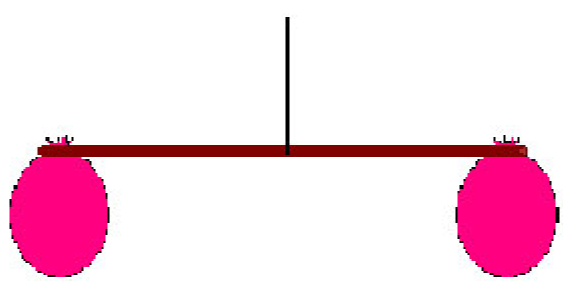


Temperature - Spacing of atoms in the atmosphere

Weight of Air

MATERIALS

- Two balloons
- One piece of string
- One push pin
- A meterstick
- Three pieces of tape



QUESTION

- Does a balloon filled with air weigh more than, less than, or the same as an empty balloon?

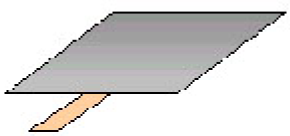
PROCEDURE

Step 1
Blow up one balloon and leave one deflated. Tape one balloon to each end of the stick.
Step 2
Tie the string to the center of the stick. Tape the string in place. Observe the position of the stick and balloons.

CONCLUSION

- Discuss what happened to the stick and balloons.
- Answer the question posed in the beginning of the activity.

A Heavy Newspaper



MATERIALS

- wooden paint stirrer (or ruler)
- full sheet of newspaper

QUESTION

- How do we know air pressure exists?

PROCEDURE

Step 1
Place an entire sheet of newspaper flat on a table, right next to the table edge. Place the wooden paint stirring stick underneath the newspaper with approximately one-third of the stick hanging over the edge of the table.
Step 2
Be careful that other students stand back. Bring your hand down very rapidly on the end of the stick, which is hanging out. Observe what happens.

CONCLUSION

- Discuss what happened to the stick and newspaper.
- Answer the question posed in the beginning of the activity.

Canned Lungs

MATERIALS

- Small can (one side open)
- Balloon
- Rubber band
- Tape
- Straw or rubber tubing
- Glass of water

QUESTIONS

- How do your lungs use air pressure to take in air?

PROCEDURE

Step 1
Cut a hole in the closed end of the can just large enough for the tube or straw to go through. Cut the bottom of the balloon off and cut up one side of the balloon.
Step 2
Stretch the balloon over the open end of the can so that it is completely covered. Do not pull the balloon too tight. It needs to be loose enough that you can grasp the top with

your fingers. Tape the ends of the balloon down around the can. Put the rubber band tightly around the balloon and tape to make sure it is air tight.

Step 3

Push the straw or tubing into the hole in the closed end and tape around the hole and the straw so that it is also air tight. Place the end of the straw in the water and pull up on the balloon. Observe what happens to the water in the straw or tubing.

CONCLUSION

- Discuss what is happening to the air in the can.
- Why was the water drawn up into the straw?
- Answer the question posed in the beginning of the activity.

Can Crush

MATERIALS

- Soda can. (Make sure the can is empty and clean of any fluid.)
- Water
- Hot plate
- Ice water bath

QUESTION

- How much pressure is pushing down on us?

PROCEDURE

Step 1

Put a very small amount of water in the can. Heat the water in the can until it boils.

Step 2

Remove the can from the hot plate, and quickly put the can upside down in the ice bath.

CONCLUSION

- Discuss what happened to the can.
- Answer the question posed in the beginning of the activity.

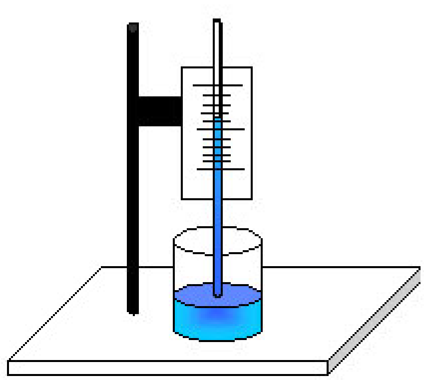
ACTIVITY THREE

How do we measure atmospheric pressure?

In this activity students will build their own liquid and aneroid barometers.

TEACHER PREPARATION

All matter has mass and takes up space, including air. Air constantly exerts pressure on our bodies, but our bodies do not crumble because they were designed to withstand the atmospheric pressure by exerting an equal and opposite pressure of their own. The first instrument used to measure atmospheric pressure was the mercury barometer, invented in 1643 by Evangelista Torricelli. It was an evacuated glass tube, inserted into a dish of mercury. The air pressing down on the mercury in the dish forced some of the mercury up into the glass tube. The height to which the mercury rises in the glass tube is directly proportional to the atmospheric pressure. This is usually measured in inches of mercury, but other scales are often used. Another type of barometer, called an aneroid barometer, is more commonly used today in meteorology and aviation because it takes up much less space and is more accurate.



Liquid Barometer

MATERIALS

- Glass barometer tube 36" long, closed at one end
- Small glass or beaker
- Colored water
- Ring stand with clamp
- Cardboard strip, 2" x 10"
- Scotch or masking tape
- Yardstick

QUESTION

- How do we measure the air pressure?

PROCEDURE

Step 1
Pour the colored water into the barometer tube, filling it completely. Pour the remaining water into a beaker. Place a finger over the open end of the tube and invert the tube, lowering it carefully into the beaker containing the remainder of the water. Clamp the tube upright on the ring stand.

Step 2
Mark a scale of centimeters on the cardboard, and label it from 50 to 100. Attach the scale to the on the tube.

Step 3
Watch the day-to-day variations in the height of the mercury. Record your readings.

Aneroid Barometer

MATERIALS

- Plastic wrap
- Metal coffee can (open at one end)
- Coffee stir straw
- Tape
- Cardboard (10 cm wide and 10 –20 cm taller than the can)
- Rubber band

QUESTION

- How do we measure air pressure?

PROCEDURE

Step 1
Cover the open end of the coffee can with the plastic wrap and secure tightly with the rubber band. Tape one end of the straw to the center of the plastic wrap covering the can. Fold the cardboard so that it stands straight up and extends about 10 cm above the can.
Step 2
Position the cardboard so that the free end of the straw just barely touches the front of the cardboard. Make a mark where the straw touches the cardboard. Extend a line across the cardboard at this point. Also draw two more lines, one 2 cm above and one 2 cm below the line.
Step 3
Reposition the cardboard so the straw just touches. Put your barometer where it will not be disturbed. Tape the cardboard down to the table so that it does not move. Observe any changes in the position of the straw for the next week or longer.

CONCLUSION

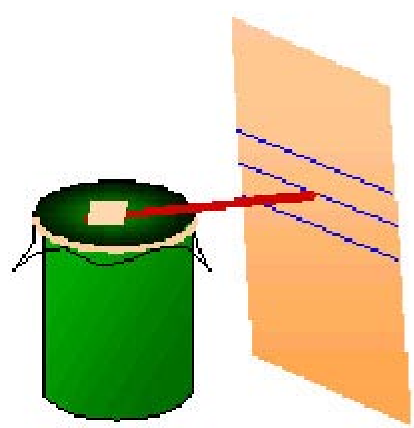
- Discuss the changes in the level of water in the liquid barometer and the straw in the aneroid barometer and what caused these changes.
- Discuss how the barometers measure pressure.
- Answer the question posed in the beginning of the activity.
- Compare the changes in the barometers to the changes in the weather.

EXTENDED ACTIVITY

Barometer Conversions

Have the students find the actual barometric readings for the day in their local newspaper, from a television report or on the Internet. Have them compare the scale on their barometers to the actual barometric pressure of the day. Have them find conversions from one scale to the other.

The National Weather Service
http://www.nws.noaa.gov/



ACTIVITY FOUR
How do we measure humidity?

In this activity students will build their own psychrometers and measure relative humidity levels around their school.

TEACHER PREPARATION

Air's ability to hold water vapor depends on the temperature of the air. As the temperature increases, the air's capacity for water vapor increases. An increase in temperature causes the molecules in air to spread apart which creates more space for water molecules. The amount of water vapor in the air compared with the maximum amount of water vapor that the air is able to hold at a given temperature is called the relative humidity. Relative humidity is given as a percent and is calculated using the following formula: Relative humidity(%) =

$$\frac{\text{amount of water vapor in the air}}{\text{water vapor capacity}} \times 100$$

One instrument that measures relative humidity is a psychrometer. A psychrometer contains two thermometers. The bulb of one thermometer is covered with a wet piece of cloth. It is called a wet-bulb thermometer. When water evaporates from the cloth, the wet-bulb thermometer shows a decrease in temperature because the process of evaporation requires heat. The other thermometer is called a dry-bulb thermometer. Since no evaporation takes place on the bulb of this thermometer, the dry-bulb thermometer's temperature does not change.

If the air is dry, water evaporates quickly from the wet-bulb thermometer and there is a large decrease in the wet-bulb temperature. This makes the difference in the temperatures of the two thermometers large. When the air is holding a large amount of water vapor, little water evaporates from the wet-bulb and the difference between the temperatures of the two thermometers is small. The difference in temperatures is an indication of the amount of water vapor in the air. A relative humidity conversion table allows you to use these two temperatures to determine relative humidity.

In this activity, the students will predict the location where the relative humidity will be the highest and lowest in and around their school. The students will then use either a sling psychrometer or two thermometers to measure the relative humidity of the various locations. The students will need to be able to read a thermometer accurately and they will be required to read a relative humidity conversion table.

The students can either make their own handmade psychrometers or be provided with sling psychrometers. Sling psychrometers can be purchased from most science equipment supply companies.

MATERIALS

- Two thermometers or sling psy chrometer
- Cheese cloth
- Two pieces of cardboard
- Relative humidity conversion table
- Pencil
- Data table

QUESTIONS

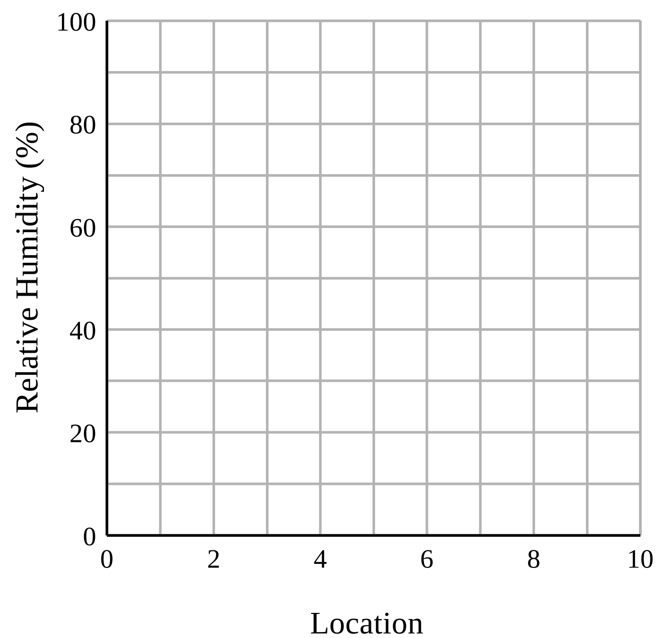
- How do we measure relative humidity?
- Where are the areas of high and low humidity in and around your school?

PROCEDURE

Step 1
Wrap the cheese cloth around one thermometer. Wet the cheese cloth with tap water and squeeze out the excess. This is the wet-bulb. Lay the two thermometers down on a piece of cardboard. Tape them to the cardboard.
Step 2
With the second piece of cardboard, fan the two bulbs. After fanning for a minute, take a reading of the temperatures of each bulb and write them down in Data Table 1. Calculate the difference between the wet-bulb and dry-bulb temperatures. Find this number in the top row of the relative humidity table. Find the dry-bulb reading temperature in the left-hand column of the relative humidity table. Find where the column for the difference numbers and the row for the dry-bulb temperature meet. Record this as your relative humidity. Once you have calculated the relative humidity, calculate the average relative humidity for the room using the data from the other groups in the class.
Step 3
Predict where you think the highest and lowest relative humidity will be in or around your school. Write down your predictions and tell why. Share your answers with your lab partners and the class.
Step 4
Get your groups assigned locations around the school from your teacher. Fill in the blank spaces on the data table with those places around the school.
Step 5
Once you are at the location assigned, repeat Step 2.
Step 6
Each time you move to a different spot to calculate the humidity, use your hand to warm up the wet bulb thermometer. Re-wet the cheese cloth before each new location.

CONCLUSION

- If there are large differences at any location, discuss possible reasons for this.
- Construct a graph of the results on the data table of averages.
- Discuss where the relative humidity was the highest and why.
- Discuss where the relative humidity was the lowest and why.



Data Table 1

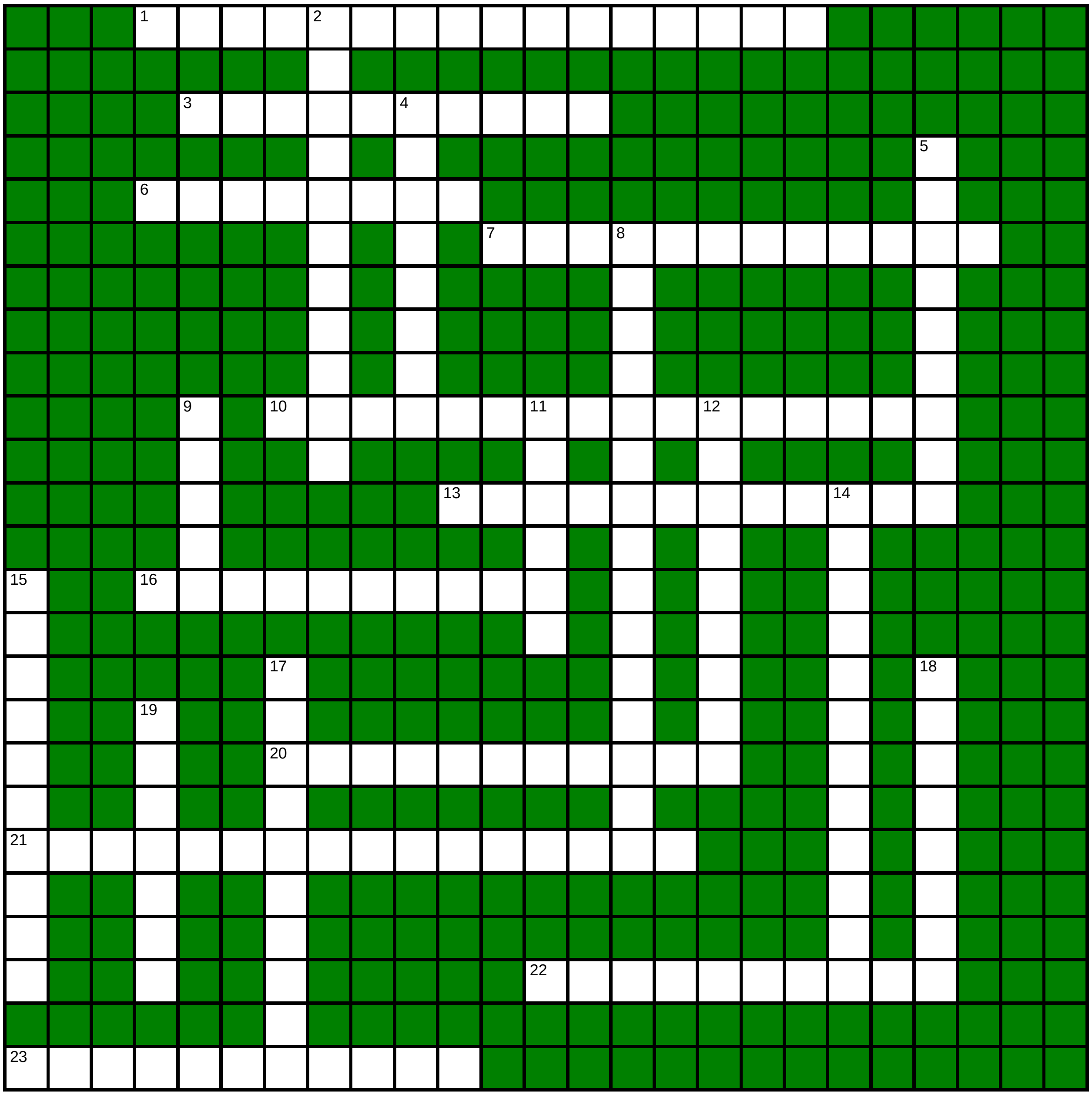
Location	**Dry Bulb Reading (°C)**	**Wet Bulb Reading (°C)**	**Temperature Difference (C°)**	**Relative Humidity (%)**

Location	**Average Relative Humidity %**

Relative Humidity Table

Dry-bulb Reading (°C)	Difference between wet-bulb reading and dry-bulb reading (°C)									
	1	2	3	4	5	6	7	8	9	10
0	81	64	46	29	13					
2	84	68	52	37	22	7				
4	85	71	57	43	29	16				
6	86	73	60	48	35	24	11			
8	87	75	63	51	40	29	19	8		
10	88	77	66	55	44	34	24	15	6	
12	89	78	68	58	48	39	29	21	12	
14	90	79	70	60	51	42	34	26	18	10
16	90	81	71	63	54	46	38	30	23	15
18	91	82	73	65	57	49	41	34	27	20
20	91	83	74	66	59	51	44	37	31	24
22	92	83	76	68	61	54	47	40	34	28
24	92	84	77	69	62	56	49	43	37	31
26	92	85	78	71	64	58	51	46	40	34
28	93	85	78	72	65	59	53	48	42	37
30	93	86	79	73	67	61	55	50	44	39

ATMOSPHERE



ATMOSPHERE CLUES

ATMOSPHERE CLUES

Across

1. comparison of the amount of water vapor in the air and the water vapor capacity

3. blanket of air above Earth

6. makes up approximately 78% of the atmosphere

7. layer that contains jet streams and ozone

10. the _____ maybe be increasing the temperature of Earth

13. instrument used to measure relative humidity

16. layer where most meteors burn up

20. measure of hot and cold

21. measure of the amount of water vapor in the air

22. layer containing charged particles

23. a weather man has the job of ______ the weather

Down

2. layer where weather occurs

4. force pushing on a certain amount of area

5. a ____ is used to measure pressure

8. particles in the air

9. layer of oxygen that filters harmful UV rays

11. makes up approximately 21% of the atmosphere

12. highest layer of the atmosphere

14. layer that is very sensitive to temperature changes

15. humidity is the measure of the amount of _____ in the air

17. river of air in the stratosphere

18. height above the Earth

19. electrical lights around the north and south poles